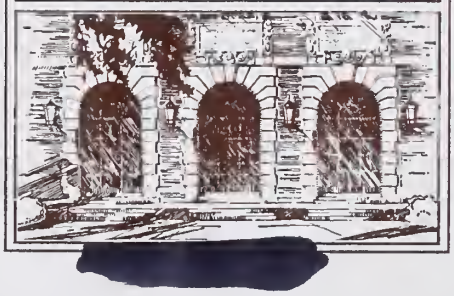

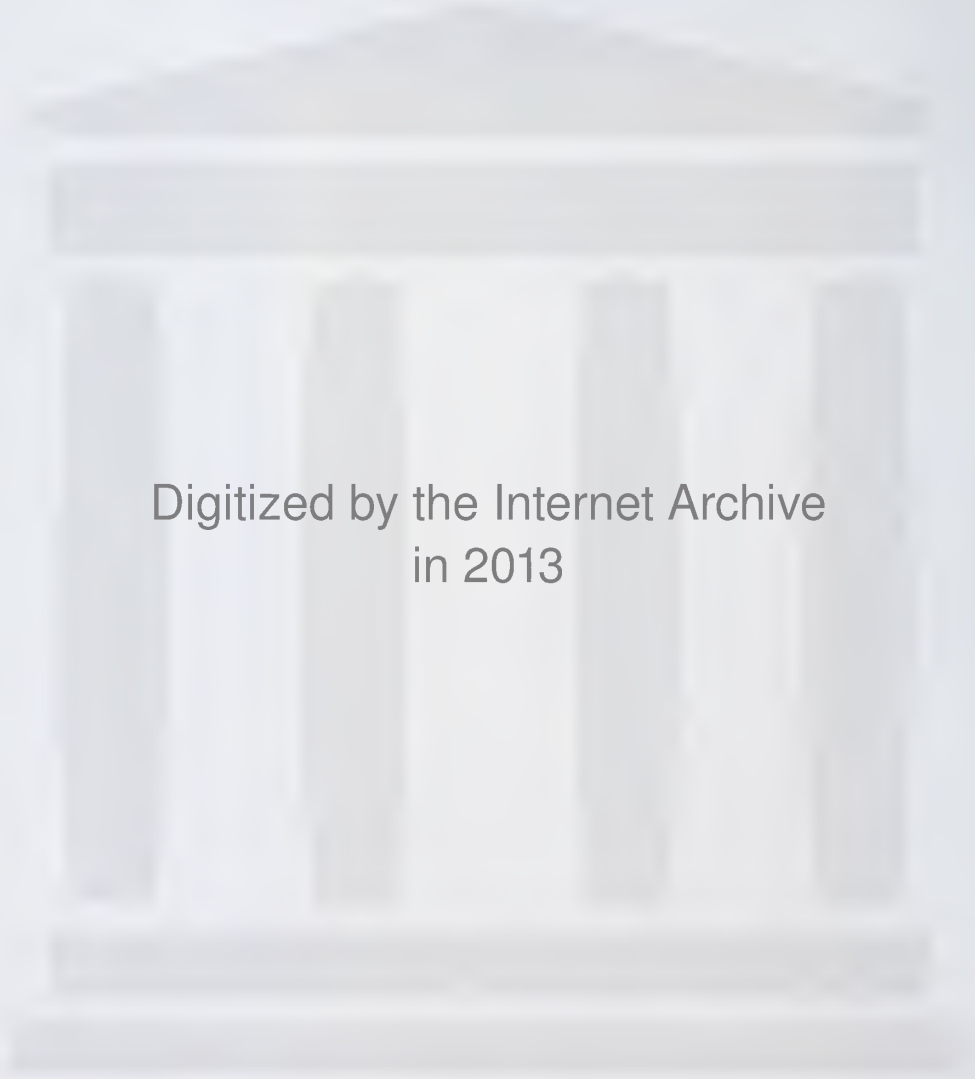

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CS 103 PLATO EXPERIMENT, FALL 1974

by

Richard G. Montanelli, Jr.

July 1975

DEPARTMENT OF COMPUTER SCIENCE
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN · URBANA, ILLINOIS

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Richard G. Montanelli, Jr.

Department of Computer Science
University of Illinois at Urbana-Champaign
Urbana, Illinois 61801

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Table of Contents

1. Introduction

For the past several years, the Department of Computer Science of the University of Illinois at Urbana-Champaign has been developing computer software for the PLATO Computer-Aided-Instruction (CAI) system (Alpert and Bitzer, 1970) to aid in teaching introductory computer science courses (Nievergelt, 1975). This author has been responsible for designing and coordinating the development of a series of PLATO lessons to teach the computer programming language FORTRAN. The series consists of about 15 lessons (only 12 of which were completed in time for use in this experiment, see Table 1) and a student should spend an average of 40-50 minutes using each lesson. The lessons consist of displays, diagrams, textual material, and quizzes, and the students interact with the lessons to learn the material and are typically quizzed over it during the lesson, so they can check out their understanding.

The lessons were initially written mainly by students for class and independent study projects, and were revised and improved by members of the staff.[1] Thus the lessons do not follow a particular teaching method or style, but each covers the assigned material in its own way. Examples of displays from lessons are presented in Figures 1 and 2.

Figure 1 is taken from lesson fortintro, which students took during the first week of class. In it, the student gets a problem, and he constructs a flowchart using natural English (actually the small but usually sufficient subset which the program understands), with the

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[1]The author would especially like to thank Dr. H. G. Friedman, Sandra Leach, and Jeffrey Barber for their invaluable help in this area.

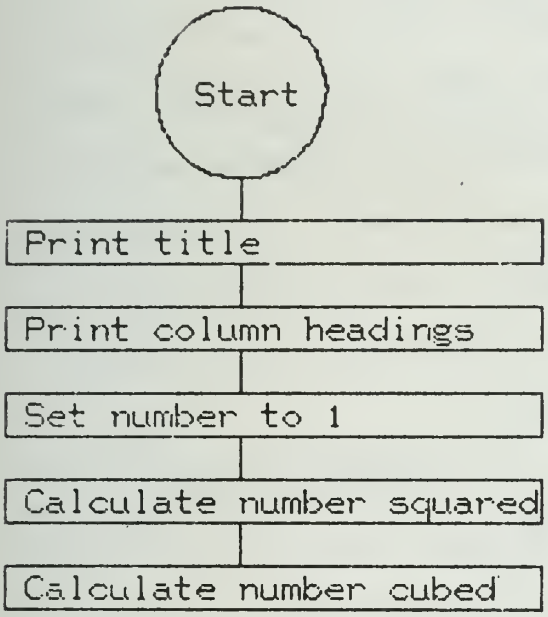
Table 1

PLATO Lessons Used

Week	Lesson Name	Author(s)	Brief Description
1	csintro	P. Kimble	Introduction to computers
1	fortintro	R. Montanelli	Introduction to programming
2	fortarith	J. Barber	FORTRAN arithmetic
3	fortfmt1	G. Strass	Simple FORTRAN print formats
4	fortarray1	H. G. Friedman K. Levin, J. Fill	One dimensional FORTRAN arrays
5	fortif	G. Strass	FORTRAN IF statements
7	fortdo	B. Barta	FORTRAN DO loops
8	sorting	J. Cupec	Sorting algorithms
9	fortarray2	L. Kawell	Two dimensional FORTRAN arrays
10	fortfmt2	D. Dodgson, A. Papamarcos, N. Klein	Advanced FORTRAN formatting
11	fortsubl	K. Slaughter	FORTRAN subroutines
13	fortchar	V. Guarna	FORTRAN character handling

Figure 1

PLATO Display from Lesson fortintro



What should the computer do next?

»

Press HELP for a general hint.
Use ERASE to change an answer.
Press DATA to see computer printout
Press NEXT to check your answer.

computer's help. The problem is to create a table of the numbers from 1 to 25 inclusive, with their squares and cubes. Students are first shown a description of the problem and a copy of the computer output. Then they try to answer the questions to create the flowchart. The answer to the question in Figure 1 is "Print number, square, and cube", but the program can accept a reasonable range of correct answers, like "The computer should output the number and its square and cube.". This is possible mainly through the use of synonyms and ignorable words. Some incorrect answers like "Print number" are answered by a suitable response "The computer prints an entire line at a time. Something else should be on the line, also. Press ERASE and try again." After each incorrect answer whether understood or not, the student gets a more detailed hint, until finally the answer is given.

Figure 2 shows a drill from the 2-dimensional array lesson fortarray2. After some introduction to 2-dimensional arrays, the student is expected to enter the appropriate subscript at the arrow (in cell 3,3 in the figure) which is flashed on and off to get the student's attention. Each student responds to five (or more if he wants) of these subscript pairs.

In order to study the effectiveness of these lessons in teaching FORTRAN, an experiment was designed, using CS 103, an introductory computer programming class for students in the behavioral and social sciences. Since about 1/2 of the class time is spent on FORTRAN, it seemed ideally suited for the experiment.

Figure 2

PLATO Display from Lesson fortarrayl

To set up this table we have used the following statement: REAL RAT(8,4)
Imagine that each block in the table represents a variable in this array. (The name of the variable is at the top of each block.)

What integer should be inserted at the arrow ?

WEIGHT	AGE	SEX	LENGTH
RAT(,)	RAT(,)	RAT(,)	RAT(,)
10.6	50.	1.	11.7
RAT(,)	RAT(,)	RAT(,)	RAT(,)
14.3	48.	2.	9.4
RAT(,)	RAT(,)	RAT(,)	RAT(,)
9.8	45.	2.	12.3
RAT(,)	RAT(,)	RAT(,)	RAT(,)
11.5	52.	1.	10.5
RAT(,)	RAT(,)	RAT(,)	RAT(,)
12.0	55.	2.	11.8
RAT(,)	RAT(,)	RAT(,)	RAT(,)
13.2	60.	1.	10.5
RAT(,)	RAT(,)	RAT(,)	RAT(,)
15.8	49.	1.	12.2
RAT(,)	RAT(,)	RAT(,)	RAT(,)
11.7	51.	2.	10.9

Example 1

2. Method

CS 103 is ordinarily taught with 2 lectures and 1 discussion meeting per week. The lectures bring all the students (56 in this case) together, and they are split into 4 groups of 10-20 students each for discussions with a teaching assistant at the end of the week. For this experiment, 1/2 of the students were randomly selected to attend a one-hour PLATO session instead of one of the ordinary lectures. This was done by assigning students with odd computer numbers to the PLATO (P) group. The computer numbers were handed out as students entered the classroom on the first day. The remaining students (the non-PLATO or NP group) acted as a control group and were taught in the traditional manner, without PLATO.

The two groups of students were kept separate for the entire semester, using the following procedures: 1) Students were fully informed about the nature of the experiment and were assured that if the two groups demonstrated significantly different levels of achievement, the group achieving the poorer record would have its grades raised to match those of the better group. 2) The PLATO terminals were reserved for 9:00 am. Wednesday morning, the same time as the lecture met. Thus, it was impossible for a student to attend the lecture and the scheduled PLATO session. Although a student could try to take his PLATO lesson at some other time, due to the heavy scheduling of terminals and the shortage of ECS (computer secondary memory), it was very difficult for a student to take a lesson at some other time. 3) The lessons were restricted so that no one except students in CS 103 and a few people on our staff could execute them.

Throughout the semester, the students were compared on various measures of achievement (computer programs, two hour exams, and the final exam) and on interest and satisfaction questionnaires.

3. Results

a. Questionnaires On the first day of class, the students completed two questionnaires (biographical data and attitude toward computers, see appendices A and B). In order to make sure that the two groups did not differ on any relevant variables, they were compared on the following variables from the above questionnaires, using t-tests or χ^2s where appropriate: age, sex, year in school, grade point average, number of hours of college math, number of hours of statistics, computer experience, and various attitudes toward computers. None of these variables indicated a significant difference between the two groups.

Six weeks into the semester, after the first hour exam, students were asked for their opinions on the course (appendix C). Forty-four students responded when asked if they would like to switch to the other group. The responses were:

	yes	no	don't know	don't care
P	3	16	2	0
NP	3	11	4	5

Responses of the non-PLATO group to the questions about their smaller lecture and of the PLATO group about the PLATO lessons are presented in Tables 2 and 3. To summarize, the NP group thought that the class atmosphere was somewhat more casual and that they could get questions answered more easily in the smaller lecture. The P group felt that the lessons were enjoyable, better than lectures on the same topic, and that they learned something from them.

Table 2

Responses of the NP Group to Questions about Comparing Their Smaller Lecture to the Large One

A. Keeping up with the lecture is:			
	easier (2)	no difference (21)	
B. Getting questions answered is:			
	much easier (1)	easier (8)	no difference (14)
C. The atmosphere of the class is:			
	more casual (9)	the same (14)	
D. If the entire class were together you would learn:			
	the same (17)	less (6)	

In the above table, only those responses used are listed, and the number of students giving each response is given in parentheses.

Table 3

Student Reactions to PLATO Lessons

A. Compare the lesson with how a lecture might teach the same topic.

The lesson was	a. much better	b. better	c. equal	d. worse	e. much worse	omits
1. csintro	2	7	6	2		4
2. algolingo*		2	3	3		13
3. fortintro	4	9	3	2		3
4. fortarith	5	7	3	2		4
5. fortfmtl	2	6	7	3		3
6. fortarrayl	2	2	11	3		3
7. fortif	2	4	7	3	2	3

B. How helpful was the lesson for the exam?

	a. extremely	b. very	c. somewhat	d. not at all	e. harmful	omits
1. csintro	1	4	10	3		3
2. algolingo*		3	5			13
3. fortintro	2	3	12	1		3
4. fortarith	3	9	5			4
5. fortfmtl	1	7	9			4
6. fortarrayl	2	2	12	2		3
7. fortif	1	2	11	2	1	4

Table 3 (cont'd)

C. How much did you learn from the lesson (whether the material was on the exam or not)?

		a. very much	b. quite a bit	c. some	d. very little	e. nothing	omit
1.	csintro	1	9	6	2		3
2.	algolingo*	1	3	3	1		13
3.	fortintro	1	11	5	1		3
4.	fortarith	6	7	4			4
5.	fortfmtl	3	6	8			4
6.	fortarrayl	3	8	5	1	1	3
7.	fortif		6	11	1		3

D. How much did you enjoy the lesson?

		a. very much	b. quite a bit	c. very little	d. not at all	e. hated it	omit
1.	csintro	4	9	5			3
2.	algolingo*	3	2	3			13
3.	fortintro	4	11	3			3
4.	fortarith	6	8	3			4
5.	fortfmtl	5	7	5			4
6.	fortarrayl	5	7	4	1	1	3
7.	fortif	3	9	4	1	1	3

* optional lesson

b. Drop rates Although 56 students actually attended at least one class session and thus were assigned to a group, only 47 remained at the end of the semester. Of the other nine students (see Table 4) two were never actually enrolled and three others never even turned in the first homework problem which was due the second week of class and was basically only a keypunching exercise. Thus of 51 students who actually began the course, only four dropped. The comparable figures for fall 1973 were that 73 students began the course and 12 dropped. These two sets of figures are not significantly different, and any trend toward fewer drops in fall 1974 is undoubtably due to the fact that the experiment itself helped maintain student interest.

Comparisons between the two groups in fall 1974 are equally non-significant. Of the four students who dropped after doing some work, two were from each group. Although four of the five other students were in the NP group, it would be extremely difficult to attribute these losses to anything other than chance.

Table 4

Analysis of Drops

Number of Students	Group	
1	NP	met one class, never enrolled
1	NP	auditor, did no work
3	1P, 2NP	did no work
3	2P, 1NP	dropped after first exam (6 weeks)
1	NP	dropped after second exam (11 weeks)

c. Achievement Grades in CS 103 are based on four components: machine problems (computer programs), two hour exams, and a final exam. Means and standard deviations for the two groups on these four variables are presented in Table 5. Although the NP group did better on all three exams, the multivariate test for differences between the two groups was not significant ($F = 1.54$ with 4 and 39 degrees of freedom). This test was based on the 44 students who took all three exams (Of the 47 students who finished the course, two skipped the final exam and failed the course, while one had an excuse from the second hour exam.).

Table 5

Means and Standard Deviations of the

Two Groups on the Achievement Variables

		Machine Problems	Hour Exam 1	Hour Exam 2	Final Exam
PLATO	means	152	67	54	141
	SDs	28.3	15.9	18.0	33.0
non-PLATO	means	152	74	67	153
	SDs	23.9	13.4	17.1	26.0

Univariate analyses of variance for these same four variables are presented in Table 6, for two reasons: First, to include each student who took any particular exam (or worked on several machine problems) in the analysis for that variable; and secondly to point out the near significant results (at the .05 level) on the two hour exams. Although these results do not show significant differences between the two groups in knowledge gained in the course, they indicate a possible problem which should be watched in the future.

Table 6

Univariate Analyses of Variance

on the Achievement Variables

Variable	Mean square	Degrees of Freedom num	denom	F	P
Machine problems	51	1	49	.03	.85
Hour exam 1	799	1	49	3.89	.054
Hour exam 2	1527	1	45	3.81	.057
Final exam	2193	1	43	2.33	.135

It should also be mentioned here, that after the first exam, the author speculated that the fact that he made up the exam might have had some effect on the results. So for the second exam, two other professors in the department made up the exam from the textbook, using the course syllabus. Since this procedure had no noticeable effect on the results, it was abandoned for the final exam.

d. PLATO usage Students in the PLATO group entered 43 separate lessons (programs) on PLATO, during the course of the semester. The lessons could be roughly classified as required (12 of these, see Table 1), optional (7, FORTRAN or FORTRAN-related), system (4, routing and messages), and others (20 computer science lessons unrelated to CS 103). Some PLATO usage statistics, divided according to these four categories, are presented in Table 7. The most interesting statistics are that on the average, students entered 9.9 of the 12 required lessons and spent 184.5 minutes in required lessons. Although the first figure is accurate, the second is actually a minimum, due to the following three problems. First, time was not properly recorded for lesson sorting, which showed 89 uses and only a total of five minutes

spent in it, and for some other lessons which were not part of the course. Second, if the system went down or in some cases if the student quit in the middle of a lesson, no time was recorded. Finally, due to an unknown error, in some cases no time was recorded in a lesson even though the student entered the lesson one or more times. Thus, while the average student spent about 10 hours at the terminal (this data recorded independently by the PLATO system), only about 3 1/2 hours of that was properly assigned to individual lessons. A table of these statistics by individual lesson is presented in Appendix D.

In order to discover the relationship between time spent on the required PLATO lessons and course grades, these two variables were correlated. The resulting correlation of .58 which accounts for about 34% of the variance and is significant at the .005 level indicated a strong, positive relationship between time spent on the relevant PLATO lessons and course grade. (The correlation with total time from all lessons was .44 and with total time on PLATO was .18.) In order to discover if this correlation might be an artifact due to brighter students working harder, the correlation was recomputed, partialling out GPA. The resulting partial correlation of .55 indicated that the relationship between hours on PLATO and course grade was not due to students with higher GPAs working harder on PLATO.

Table 7

Summary of PLATO Lesson

Usage per Student

	Lesson type				
	required	optional	system	other	TOTALS
Number of times entering	32.6	3.2	15.2	2.0	53.0
Time spent (in minutes)	184.5	6.1	12.6	4.6	207.8
Number of lessons	9.9	1.5	2.6	1.0	15

e. Course evaluation questionnaire The Computer Science Department routinely administers a standardized course evaluation questionnaire (Appendix E) in each of its courses, near the end of the semester. Although the questionnaires are administered anonymously and thus could not be separated into PLATO and non-PLATO groups, it was thought that some comparisons might be made with results from the previous year (fall, 1973), and that some comments about PLATO might be made in response to the open-ended questions on the back of the questionnaire.

The 42 objective questions were scored on a 4, 3, 2, 1 scale (for responses A, B, C, and D), and analyses of variance were performed for each question between the two semesters. Results are in appendix E. Even if one tried to interpret all of the significant results (which would be a very questionable statistical procedure, due to the correlations between the questions, and the pure probabilities which state that about 2 of 42 such tests would be significant at the .05 level by chance), nothing of interest

is found. Most of the results appear to be unrelated to the experiment, such as the 1973 group reporting that the instructor's voice was more animated and that he varied the pace of lecturing more than the 1974 lecturer or the 1974 group saying that grading of machine problems was more fair or that TAs were better supervised. (The author was the instructor in both cases.) Others were related, but unimportant. (i.e. The 1973 lectures were more related to the reading assignments, because the PLATO lessons essentially replaced the lectures which would have gone over the reading material.)

Of the 29 students who completed the questionnaire, 6 mentioned PLATO on the back. While one of these was from a student who had wanted to get a chance to use PLATO (presumably from the NP group!), the other five were critical to varying degrees. A couple made general comments like "it was frustrating" or the lessons were "too philosophical", while two others suggested that PLATO should be eliminated or improved.

These sentiments were basically repeated in responses to the question "How would you improve the course" which was part of a short questionnaire attached to the final exam. Additionally, three students mentioned that they needed more time on PLATO.

4. Discussion

There were three interesting results of the study. First, although students seemed reasonably satisfied with PLATO early in the semester, the comments made at the semester's end indicated some dissatisfaction. Four possible explanations are: 1) early in the semester students find PLATO new and interesting, but the novelty wears off by the semster's end, 2) students are more concerned with grades at the end of the semester, 3) earlier lessons were in better shape than later ones, and 4) ECS problems were worse later in the semester. Undoubtably each of these explanations played some part in student attitudes, and of course little can be done to change the effect of the first two. However, it was the case that some of the earlier lessons were better tested than some of the later ones. Thus some additional improvements for these lessons might be indicated. Finally, the shortage of ECS could have had a larger effect at the end of the end of the semester, because as students fall behind or need to review, they create a demand for many lessons at the same time, and that wasn't possible. However, added ECS in January, 1975 removed this problem.

The most encouraging result was the strong relationship between the amount of time spent in the required PLATO lessons and the course grade. If this is a cause and effect relationship, it illustrates the usefulness of the lessons.

The final interesting result was the lack of a significant difference between the two groups on achievement variables. With some of the problems encountered, this result was good, in spite of the

fact that the observed differences favored the NP group.

The above results suggest several improvements in the course. First, one of the benefits of CAI is its self-pacing, self-scheduling feature, and this was basically absent due to the lack of ECS, but this problem has now been remedied. Secondly, efforts are being made to improve the quality of many of the lessons. These mainly involve increased use of animation, simulation, exercises, and other forms of interactive material to help maintain student interest and allow students to practice what they have learned.

An example of a new exercise appears in Figure 3. For this experiment, the introductory formatting lesson fortfmtl consisted of a lot of text with a fairly small number of exercises for the student. In response to student comments that the lesson was dull and to complaints that it didn't give students a chance to practice, three of these exercises were added (for I, F, and E formats) and a simulator is being written. The problems for the exercise are generated randomly (within some constraints), and students type in answers in the boxes until they achieve the criterion set by the instructor (5 correct in this example). The computer keeps track of students' results, and lets them procede when the criterion is met.

A third possible mechanism for improving student performance would be through encouraging or forcing the students to take the PLATO lessons. In CS 103, students were told to use the lessons, but apparently some did not, although there were some problems with the timing data. In any case, the CAISMS project (Anderson et al, 1974) using computer-managed instruction showed that students performed better if they were forced to study. Also, the correlation between course grade and time in the required lessons in this study indicated that using the lessons improved

Figure 3

PLATO Display from Lesson fortfmtl

PAGE 13.

EXERCISES IN I FORMATS

Below you will be given an INTEGER and a FORMAT statement and then you are to show how that number would be PRINTed. In this exercise spacing is important and will be checked in determining whether or not your answer is correct. You must get 5 problems correct to continue with this lesson.

To indicate that a number is too large for the format use *'s to fill in the field.

INTEGER NUMBER → -282

FORMAT SPECIFICATION → I5

YOUR ANSWER » [____]

You now have 4 of 4 correct.

Press -STOP- to continue with the lesson.

grades. Perhaps some small amount of credit could be given to students who complete lessons, in order to encourage them to do so. It should be noted that the effect of PLATO on CS 103 (or perhaps any course) may be greater than the simple substitution of 50 minutes of CAI material for a 50 minute lecture. Students may be more likely to skip a PLATO lesson than a lecture because they could do it later or because there is no instructor to notice their absence. Additional work should consider student motivation and attendance at PLATO and in lectures.

In summary, CAI materials can replace some lectures on the FORTRAN language in an introductory computer science course. However, more effort must be spent on lesson development and evaluation than was originally suspected.

References

Alpert, D. and Bitzer, D. L. Advances in Computer-based Education. Science, 167, March 1970, 1582-1590.

Anderson, T. H., Anderson, R. C., Dalgaard, B. R., Wietecha, E. J., Biddle, W. B., Paden, D. W., Smock, H. R., Alessi, S. M., Surber, J. R., and Klemt, L. L. A Computer-based Study Management System. Educational Psychologist, 1974, Vol. 11, No. 1, 36-45.

Nievergelt, J. Interactive Systems for Education - The New Look of CAI. Invited paper. IFIP World Conference on Computer Education, Marseilles, France, September, 1975.

APPENDIX A

QUESTIONNAIRE
Computer Science 103

USER number _____ Signature _____ Soc. Sec. No. _____
(4 digits from upper
right of envelope)

Attitude toward Computers

Please check your degree of agreement or disagreement with each of the following statements:

	STRONGLY AGREE	AGREE	DISAGREE	STRONGLY DISAGREE
Computers are infallible	_____	_____	_____	_____
Computers are overrated	_____	_____	_____	_____
Computers dehumanize institutions	_____	_____	_____	_____
Computers are useful to society	_____	_____	_____	_____
Computers are often misused	_____	_____	_____	_____
Their advantages outweigh their disadvantages	_____	_____	_____	_____

Please check your familiarity with PLATO:

never heard of it	heard about it	tried it once or twice	used it in a class
_____	_____	_____	_____

have programmed it

_____

Familiarity with computers other than PLATO:

never used one	ran a program or 2 (SOUPAC, for ex.)	know a little FORTRAN or some other language	had a course or considerable experien
_____	_____	_____	_____

APPENDIX B

CS 103 Biographical Questionnaire Fall 1974

In order to make some of the later machine problems more interesting, the data obtained from this class, via this questionnaire, will be used. You will be given copies of this data and asked to compute some statistics (all of which will be explained in class) on it. Additionally, this information will be used to examine the degree of variation in the backgrounds of the students, so that the material presented will be at the appropriate level.

Please mark you answers in the space on the right.

1. Social Security number — 1 9
2. Sex (M or F) — 10
3. Departmental abbreviation (eg. PSYCH, SOC, or NONE if unassigned) — 11 16
4. Age in years — 17 18
5. Year in school (1 for Freshman, 2 for Soph., 3 for Jr., 4 for Sr., 5 for Grad.) — 19
6. Height (feet and inches) — 21 ft. 22 23 in.
7. Weight (pounds) — 25 27
8. Approximate college GPA — 29 32
9. Number of hours of college mathematics — 33 34
10. Number of hours of statistics (any departments) — 35 36
11. Computer experience — 37
    - 0 none
    - 1 a little
    - 2 used SOUPAC
    - 3 some knowledge of a language
    - 4 a lot (Why are you in CS 103?)
12. Expected grade in CS 103 (A, B, C, D, or E) — 38
13. Place a 1 if you would object to the data on this questionnaire being made available to the other students in this class. — 40
14. List the numbers of those questions whose responses you wish kept confidential.

---

15. Place a 1 if you would object to the data being made available to the class, anonymously (without soc. sec. nos.). — 42

APPENDIX C

10/7/74 NAME _____

Computer Science 103 Questionnaire

This questionnaire is an effort to get your opinions about the experiment being conducted in the class. Please take the time to carefully answer all questions which pertain to your half of the experiment. Your comments will have no effect on your grade, so please be candid and as critical as you wish.

I. EVERYBODY

A. Would you rather switch to the other section: Yes no don't know don't care

B. Below, and/or on the back, please list any comments, suggestions, and criticisms which you have of CS 103 this semester, especially any which pertain to the experimental division of the class into 2 sections. Say what you like and what you don't like about the course.

_____

_____

_____

C. List any exam questions which you feel you were unprepared for, and say why.

_____

_____

D. Would you prefer to have the next exam in the evening? Yes No

E. IF (you're in the PLATO section) GO TO IV

II. REDUCED CLASS SIZE GROUP - In answering the following questions, compare the smaller Wednesday lectures with the larger Monday lectures.

A. Keeping up with the lecture on Wednesdays is

a. much easier b. easier c. no difference d. harder e. much harder

B. Getting questions answered on Wednesdays is

a. much easier b. easier c. no difference d. harder e. much harder

C. The atmosphere in the class on Wednesdays is

a. more casual b. same c. less casual

D. If the entire class were together on Wednesdays, how much would you learn

a. a lot more b. more c. the same d. less e. much less

III. STOP, look up, yawn, and stretch to indicate you're finished.

IV. PLATO GROUP - You have had an opportunity to study the following 7 PLATO lessons so far this semester:

1. csintro 2. algolingo 3. fortintro 4. fortarith 5. fortfmtl 6. fortarrayl 7. fortif

Answer each question below, for <u>each</u> of the 7 lessons you have used.

A. Compare the lesson with how a lecture might teach the same topic.

The lesson was a. much better b. better c. equal d. worse e. much worse

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____

B. How helpful was the lesson for the exam?

a. extremely b. very c. somewhat d. not at all e. harmful

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____

C. How much did you learn from the lesson (whether the material was on the exam or not)?

a. very much b. quite a bit c. some d. very little e. nothing

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____

D. How much did you enjoy the lesson?

a. very much b. quite a bit c. very little d. not at all e. hated it

1. _____ 2. _____ 3. _____ 4. _____ 5. _____ 6. _____ 7. _____

E. GO TO III

APPENDIX D

PLATO Usage

LESSON NAME	NUMBER OF TIMES USED	NUMBER OF BAD EXITS	NUMBER OF MINUTES	NUMBER OF STUDENTS
csintro	45	7	680	23
fortintro	49	19	277	21
fortarith	101	29	678	26
fortfmt1	96	53	137	23
fortarray1	97	49	622	27
fortif	145	37	570	26
fortdo	78	40	576	26
sorting	89	77	5	22
fortarray2	48	24	276	23
fortfmt2	54	37	281	18
fortsub1	62	16	539	20
fortchar	9	5	64	5
fortfmt	16	4	0	4
fortsub	9	2	53	3
fortcomp	37	24	65	18
fortsubex	5	0	35	2
fortfunct	4	0	0	1
algolingo	6	6	0	6
flowchrt	3	3	0	3
csguide	217	17	212	26
cscomments	20	19	1	7
cslessons	161	34	116	27

csrouter	18	18	0	11
fortxl	5	2	0	2
darwinl	2	0	0	1
numquad	1	0	14	1
rootlab	1	1	0	1
machlang	1	0	1	1
cs	5	5	0	2
racetrack	13	5	100	2
basicintro	2	0	0	2
snobol	2	2	0	1
somaga	2	0	0	1
basicrefl	2	2	0	1
graphix	1	1	0	1
monte carlo	1	1	0	1
trafficsim	4	1	0	2
mazesearch	1	0	0	1
turing	1	1	0	1
kaids	1	1	0	1
csscrap	1	1	0	1
snobolcomp	2	0	0	1
minie	1	1	0	1
TOTALS	1418	544	5302	393
AVERAGES	3.6	1.4	13.5	

Note: First twelve lessons were required, next seven were optional, next four were system lessons, and last twenty were any others.

APPENDIX E

YOU CAN HELP PROMOTE GOOD INSTRUCTION BY GIVING YOUR CONSIDERED EVALUATION OF CERTAIN ASPECTS OF YOUR INSTRUCTOR AND THIS COURSE. PLEASE ANSWER EACH QUESTION INDEPENDENTLY SO AS TO GIVE A CORRECT ASSESSMENT OF WHAT YOU THINK ARE STRONG AND WEAK POINTS OF THE COURSE. IF YOU CHOOSE NOT TO ANSWER A QUESTION, PLEASE GIVE YOUR REASONS ON THE BACK.

ITEMS 1-24 DESCRIBE VARIOUS SPECIFIC THINGS THAT A LECTURER MAY DO. BLACKEN THE LETTER ON EACH LINE TO INDICATE HOW FREQUENTLY THE LECTURER IN THIS COURSE DID EACH OF THEM.

USE THE CODE ON THE RIGHT

A = ALMOST ALWAYS
B = OFTEN
C = OCCASIONALLY
D = ALMOST NEVER

xxx	xxxxxxx	1. ACTED INTERESTED IN THE MATERIAL.
xxx	xxxxxxx	2. WAS WELL PREPARED.
xxx	xxxxxxx	3. ACTED RELAXED.
xxx	xxxxxxx	4. LOOKED AT THE CLASS WHILE SPEAKING.
xxx	xxxxxxx	5. ENUNCIATED WELL.
xxx	xxxxxxx	6. LECTURES SEEMED TO GO SMOOTHLY FOLLOWING A LOGICAL SEQUENCE OF THOUGHT.
xxx	xxxxxxx	7. USED RELEVANT EXAMPLES.
xxx	xxxxxxx	8. EXPLAINED CLEARLY AND EXPLANATIONS WERE TO THE POINT.
xxx	xxxxxxx	9. EMPHASIZED IMPORTANT POINTS BY RAISING VOICE, REPEATING, ETC.
xxx	xxxxxxx	10. MADE YOU INTERESTED IN THE MATERIAL.
xxx	xxxxxxx	11. LECTURED AT THE ABILITY LEVEL OF THE CLASS.
xxx	xxxxxxx	12. LECTURES WERE RELATED TO THE READING ASSIGNMENTS.
xxx	xxxxxxx	13. GAVE CLEAR EXPLANATIONS OF ABSTRACT IDEAS.
xxx	xxxxxxx	14. MADE CLEAR THE OBJECTIVES FOR EACH LECTURE OR SERIES OF LECTURES.
xxx	xxxxxxx	15. FOLLOWED AN OUTLINE.
xxx	xxxxxxx	16. STIMULATED YOUR INTELLECTUAL CURIOSITY.
xxx	xxxxxxx	17. SEEMED TO HAVE VERY RECENT INFORMATION ON THE SUBJECT.
xxx	xxxxxxx	18. ANSWERS TO QUESTIONS WERE RELEVANT.
xxx	xxxxxxx	19. VARIED PACE OF LECTURING.
xxx	xxxxxxx	20. PRESENTED MATERIAL NOT IN THE READING ASSIGNMENTS.
xxx	xxxxxxx	21. VOICE WAS ANIMATED.
xxx	xxxxxxx	22. USED HUMOR EFFECTIVELY.
xxx	xxxxxxx	23. ANSWERED ALL QUESTIONS (OR ADMITTED DIDN'T KNOW THE ANSWER).
xxx	xxxxxxx	24. ENCOURAGED QUESTIONS DURING THE LECTURE.

THE REMAINING QUESTIONS REFER TO OTHER ASPECTS OF THE COURSE. USE THE SCALE ON THE RIGHT TO EXPRESS YOUR DEGREE OF AGREEMENT OR DISAGREEMENT WITH EACH STATEMENT.

A = STRONGLY AGREE
B = AGREE
C = DISAGREE
D = STRONGLY DISAGREE
G = NOT APPLICABLE

xxx	xxx	25. ATMOSPHERE OF THE CLASS WAS CORDIAL.
xxx	xxx	26. LECTURER WAS PATIENT WITH STUDENTS WHO DID NOT UNDERSTAND THE MATERIAL.
xxx	xxx	27. OVERALL EFFECTIVENESS OF THE INSTRUCTOR WAS GOOD.
xxx	xxx	28. INSTRUCTOR SHOULD BE RECOMMENDED TO STUDENTS TAKING A SIMILAR COURSE.
xxx	xxx	29. PREREQUISITES STATED IN THE COURSE CATALOG WERE NECESSARY.
xxx	xxx	30. MACHINE PROBLEMS WERE WORTHWHILE.
xxx	xxx	31. GRADING OF MACHINE PROBLEMS WAS FAIR.
xxx	xxx	32. WRITTEN HOMEWORK WAS HELPFUL.
xxx	xxx	33. GRADING OF WRITTEN HOMEWORK WAS FAIR.
xxx	xxx	34. EXAMINATIONS TESTED THE COURSE MATERIAL.
xxx	xxx	35. GRADING OF EXAMINATIONS WAS FAIR.
xxx	xxx	36. ADEQUATE ARRANGEMENTS WERE MADE WHEN THE PROFESSOR WAS ABSENT.
xxx	xxx	37. AUDIO-VISUAL TEACHING AIDS WERE USED EFFECTIVELY.
xxx	xxx	38. READING MATERIAL COVERED THE COURSE MATERIAL.
xxx	xxx	39. T.A.S WERE WELL SUPERVISED.
xxx	xxx	40. THE TEXTBOOK WAS GOOD.
xxx	xxx	41. A LOT WAS LEARNED BY TAKING THIS COURSE.
xxx	xxx	42. THE COURSE WAS ENJOYABLE.

PLEASE ANSWER THE QUESTIONS AND MAKE COMMENTS ABOUT THE ASPECTS OF THE COURSE INDICATED BELOW. COMPLIMENTS OF GOOD ASPECTS AND CRITICISMS OF POOR ONES ARE ALL WELCOME. YOUR COMMENTS WILL HELP YOUR INSTRUCTOR INTERPRET THE RESULTS FROM THE QUESTIONS ON THE OTHER SIDE. REMEMBER, YOUR INSTRUCTOR WILL NOT SEE YOUR COMPLETED EVALUATION UNTIL AFTER FINAL GRADES FOR THIS COURSE HAVE BEEN TURNED IN.

1. WHAT GRADE DO YOU EXPECT TO GET IN THIS COURSE? _____

2. COMMENT ON THE AMOUNT OF TIME REQUIRED BY THIS COURSE COMPARED WITH THE CREDIT GIVEN.

3. COMMENT ON HOMEWORK AND MACHINE PROBLEMS (NUMBER, DIFFICULTY, RELEVANCE, GRADING, CONTRIBUTION TO FINAL GRADE, ETC.)

4. COMMENT ON EXAMS (LENGTH, DIFFICULTY, GRADING, CONTRIBUTION TO FINAL GRADE, ETC.)

5. PLEASE COMMENT ON COURSE CONTENT AND RELEVANCE TO YOUR AREA OF STUDY.

6. NAME YOUR PRINCIPAL INSTRUCTOR _____, TA _____
WHAT ARE YOUR GENERAL COMMENTS ABOUT THE INSTRUCTOR(S) IN THIS COURSE?

7. GENERAL COMMENTS. ARE YOU SATISFIED WITH WHAT YOU GOT OUT OF THIS COURSE?
WAS IT A WORTHWHILE EDUCATIONAL EXPERIENCE? HOW WOULD YOU IMPROVE THE COURSE?

8. WHAT IS YOUR REACTION TO THIS QUESTIONNAIRE? WHAT OTHER QUESTIONS SHOULD HAVE BEEN ASKED? ANY QUESTIONS YOU DID NOT LIKE OR COULD NOT UNDERSTAND? PLEASE GIVE REASONS.

APPENDIX E (cont'd)

Computer Science Course Evaluation

Questionnaire Results

Variable	Means 1973	Means 1974	df(denom.)	F	p
1	3.57	3.41	71	.87	.35
2	3.76	3.79	72	.09	.77
3	3.07	3.34	71	1.78	.19
4	3.38	3.21	72	.99	.32
5	3.76	3.72	72	.08	.78
6	3.56	3.41	72	.67	.42
7	3.49	3.24	72	2.39	.13
8	3.11	3.00	72	.34	.56
9	3.00	2.71	70	1.89	.17
10	2.45	2.28	71	.68	.41
11	3.18	3.10	72	.16	.69
12	3.54	3.07	71	7.66	.007
13	2.77	2.48	71	2.05	.16
14	3.36	3.14	72	1.21	.28
15	3.64	3.59	71	.11	.74
16	2.42	2.28	72	.37	.54
17	3.29	3.15	70	.50	.48
18	3.36	3.31	72	.07	.79
19	2.36	1.72	71	11.54	.001

20	2.18	1.93	69	1.70	.20
21	2.39	1.76	71	8.47	.005
22	1.76	1.52	72	1.82	.18
23	3.62	3.66	72	.05	.82
24	3.27	3.34	72	.16	.69
25	3.00	3.00	70	0.0	1.00
26	3.00	3.00	72	0.0	1.00
27	3.11	2.93	72	1.02	.32
28	3.09	2.71	71	3.00	.09
29	2.89	2.60	49	1.23	.27
30	3.44	3.45	72	.00	.98
31	3.11	3.59	72	6.91	.01
32	2.63	3.00	7	.15	.71
33	2.56	3.00	10	1.05	.33
34	2.60	2.59	72	.00	.95
35	2.76	3.00	72	1.45	.23
36	3.56	3.56	32	.00	.98
37	2.17	2.29	24	.08	.78
38	3.27	3.17	72	.42	.52
39	3.33	3.68	68	5.81	.02
40	2.60	2.97	72	2.84	.10
41	3.31	3.07	72	1.45	.23
42	2.61	2.55	71	.06	.81

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15. Supplementary Notes

16. Abstracts

In order to determine the effectiveness of replacing a lecture on FORTRAN with PLATO CAI material in an introductory computer programming class, an experiment was conducted. The students in CS 103 were randomly divided into two groups, with students in the PLATO (P) group getting a PLATO lesson in place of 1 of the 2 weekly lectures, throughout the semester. Results indicated that there were no significant differences between the groups on achievement variables. Students in the P group were initially happy and satisfied with the PLATO materials, although there were a few complaints by the semester's end. These problems have been fixed, and PLATO should be able to routinely substitute for one lecture a week in introductory computer programming courses.

17. Key Words and Document Analysis. 17a. Descriptors

PLATO
CAI
Course evaluation
Teaching computer science
Educational innovation

17b. Identifiers/Open-Ended Terms

17c. COSATI Field/Group

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